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ABSTRACT

The importance of effective communication compels investigators to seek new ways of measuring physiological responses and to practice the science of psychophysiology. The main objective of psychophysiological research is to describe the systems in organisms which transfer information between the subsystems of soma and psyche. Results should lead to a full understanding of covert responses and to a greater comprehension of gross behaviors. Physiological measurement tests skin conductance, heart rate, muscle tension, blood volume, and the electrical activity of the brain. Studies done by Westie and DeFleur tested emotional responses of student attitudes toward Negroes, while others' experiments recorded skin responses to stimulus words, to certain films, and to information-loaded sentences and studied anxiety during public speaking, physiological interaction in small groups, and autonomic measures of stress under pressures of group conformity. A predominant conclusion is that successful psychophysiological studies in communication could be useful in interdisciplinary research. (DS)

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physiological measurement in communication research

by Ralph R. Behnke

Most of us would agree that modern society places more and more importance on effective communication. As a result, communication researchers are challenged to improve and extend the available methods by which to examine this process. Communication events have been studied by assessing the subjective states, physiological states, and gross behavioral activities of human subjects. One could argue that each of these different schemes of measurement contributes a special dimension to our understanding of human behavior.

I believe that the increasing interest in measuring physiological response variables in communication studies may be accounted for in several ways:

1) measurement of covert activities provides reliable information since a subject has little control over them,

2) a subject's attention need not be directed to the concepts or processes being measured,

3) physiological data are useful in attempting to validate theories or constructs based upon psychological or gross behavioral data, and

4) bio-electronic systems for the measurement of physiological responses have been greatly improved in availability, reliability, operational simplicity, and overall cost.

For the most part, these factors account for the recent upsurge in a line of research which has come to be known as *psychophysiology*. At this point it would be useful to examine this term in some detail.

After concluding that no single criterion exists which will clearly define the field of psychophysiology, Sternbach[1] combines several critical attributes of psychophysiological research resulting in a somewhat more operational definition: "Psychophysiology is the study of the interrelationships between the physiological and psychological aspects of behavior. It typically employs human subjects, whose physiological responses are usually recorded on a polygraph while stimuli are presented which are designed to influence mental, emotional, or motor behavior; and the investigator need not be a psychologist." Sternbach concludes that although his definition is not an adequate, formal one, it fairly represents the great majority of research studies to date.

Ax[2] suggests that "psychophysiology is best defined by its goals and methods as they are described in the reports published by research workers." From this point of view, psychophysiological research is clearly expanding what it considers to be its domain. The interests and concerns of communication researchers are playing an increasingly active role in this expansion. Ax goes on to say that a major goal of psychophysiology is understanding the organismic translator.

> "More specifically, the facts and principles of psychophysiology describe the translator systems for the organisms. So far psychophysiology has made real progress only in the description of the physiology of sensation, and that is far from complete . . . The general goal, then, of psychophysiology is the description of the systems in the organism which transfer information between two collections of subsystems generally referred to as psyche and soma. It is, of course, expected that present models of both psyche and soma are incomplete and in some respects erroneous, so that as the translator model develops, it will assist in the remodeling of both and, of course, be influenced by them."

I suspect that at this time the majority of published psychophysiological studies do not deal essentially with descriptions of the

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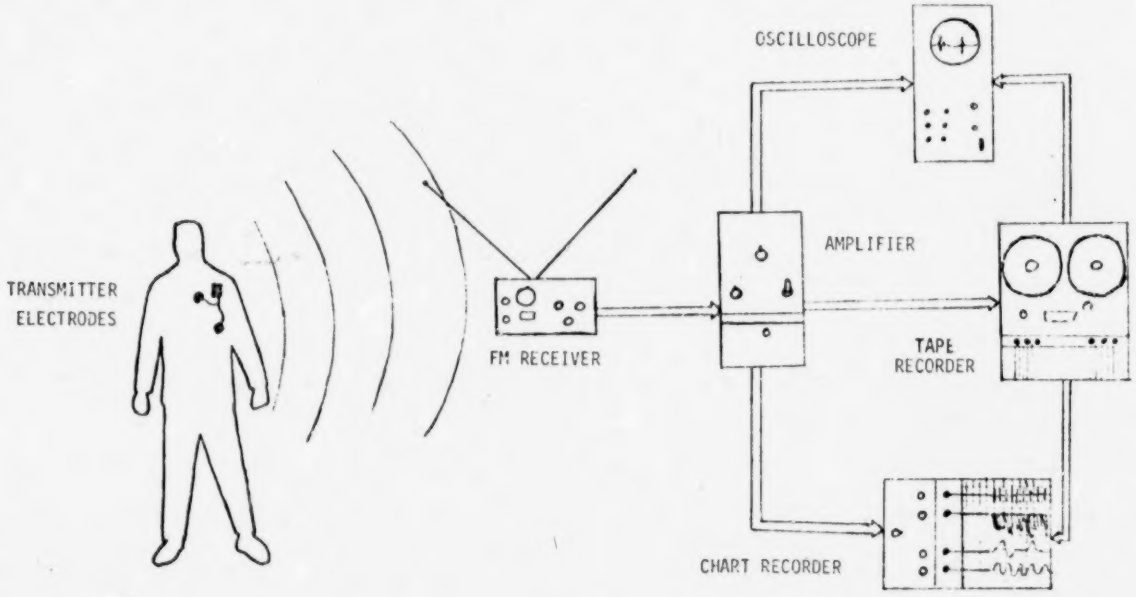
translator systems of the organism. Most of these studies deal only with the correlation or association of physiological variables with psychological, behavioral or other physiological variables.

The goals of psychophysiological researchers have been varied. Some have attempted to describe the types of responses which may be measured. Others have sought to develop suitable instrumentation and measurement schemes for these responses and yet others have attempted to determine the suitability of these measures as dependent variables in communication studies.

Among the most popular response measures are changes in skin conductance, heart rate, muscle tension, blood volume, and the electrical activity of the brain. These responses may be viewed, for example, as indices of the level of activation or arousal generated by the induction of an experimental variable. Although there is general agreement that a combination of several physiological response measures should be employed to define activation or arousal, numerous single variable definitions have been useful when restricted by operational definitions and applied to very limited constructs.[2] Of course, one of the major research objectives is to determine appropriate physiological definitions of arousal which are best suited for a specific experimental design and setting.

If we examine the instrumentation for sensing and recording physiological responses we find that it varies in complexity from a self-contained single-unit monitor and recorder to a hybrid multichannel system. Common to all types of these instruments, regardless of sophistication and complexity, are three basic components: an input mechanism consisting of a signal sensor or transducer, a signal processor or amplifier, and an output display device or recorder. It should be noted that, whenever telemetry equipment is available, the subject's responses are telemetered or broadcast to the laboratory where they are received, recorded, and processed. In this way the setting in which the experiment is conducted may be isolated from the laboratory. The development of these miniaturized battery-operated transmitters, which can be worn comfortably beneath the subject's clothing, has probably contributed most to reducing the artificiality which previously has been associated with psychophysiological research. From the schematic drawing shown in Figure I we can see the major elements of a physiological measurement system.



Electrodes, which serve as the input device, are fitted to the subject. Physiological signals picked up by the electrodes are fed to the telemetry transmitter where this information is imposed upon a radio frequency carrier wave. This composite radio signal is received in the laboratory by an FM receiver wherein the raido signal is discarded and only the physiological information is sent to the amplifier or processor. We may either direct the amplifier output to the cathode-ray tube of an oscilloscope for immediate visual display or permanently record this signal with an ink-writing chart recorder or we can elect to store the signals on magnetic tape for later playback and analysis. Such tape recordings may then be played back through an oscilloscope or a chart recorder at a later time. Unfortunately, reducing data from ink chart write-outs is a very slow and laborious process. In larger systems, the tape recorded signals are fed to a high speed digital computer for automatic data reduction and analysis. I am sure that in the future the time and energy formerly expended in visual and manual data reduction will be put to good use in improving other weak links in this line of research.

The application of a physiological response measurement system such as the one depicted in Figure I, indicates an acceptance of the proposition that overt human behavior has underlying physiological and neurological correlates. It further suggests that an understanding of these covert responses and response systems might lead to a better understanding of gross behaviors. Many of these covert responses are accompanied by energy releases which can be measured and recorded. These recordings are taken to be an index of the level of activation or state of arousal of the individual.

As I have suggested earlier, a wide range of physiological response variables has served as an index of arousal in research studies related to communication. The selection of the most appropriate physiological measure for a given research problem is a specialty in itself. Although there are some common problems of measurement and interpretation for all of the measures, each exhibits some very specialized and individualistic problems of quantification and interpretation. The electrical aetivity of the skin and heart rate are probably the most widely used indices of activation. The following selected studies deal with research problems related to communication in which the level of activation or arousal served as a variable.

Interestingly enough, although studies of attitudes and attitude change frequently appear in the research literature in communication, little attention has been given to physiological measures of attitude. I have suggested earlier that physiological information in some instances may provide a superior alternative to other attitudinal measures. Since physiological responses are difficult to control, they may well be the most "honest" ones. Furthermore, at least in the case of some rather forthright psychological scales, experimental subjects are aware of the nature of the variable which is being measured. However, in instances where a physiological measure of attitude is employed it is not necessary to direct the subject's attention to that variable. Hence the true purpose of the experiment may be more readily concealed.

Probably one of the most interesting attitude studies employing a physiological variable was reported by Westie and DeFleur.[4] On the basis of student responses on a questionnaire, they constituted a group of "prejudiced" and a group of "unprejudiced" subjects. These subjects were then shown pictures of Negroes and whites engaging in a variety of social activities. Higher levels of physiological arousal were observed for prejudiced students while they were viewing the pictures of the Negroes. In this study the self-reported and physiological measures of attitude validated each other. Loosely speaking we could say that, for the prejudiced students the pictures of Negroes generated a greater "emotional" response.

Of course, the study of "emotional" responses to communication stimuli has been a subject to which psychophysiological methods have frequently been applied. The classic study in this area was conducted by Whately Smith.[5] Smith read aloud a list of stimulus words while recording changes in skin response. He found that some words such as "kiss" and "divorce" generated high arousal or "emotion" while words such as "glass" and "pencil" evoked minimal responses. This study was repeated and verified about six years later by other investigators using most of the same stimulus material. The

relative order of the magnitude of response to each word remained essentially the same. It seems to me that the study of the arousal value of words and other messages is far from exhausted.

Communication studies of learning or information-gain have also employed psychophysiological methods. Levonian[7] recorded galvanic skin responses during a film presentation. A delayed comprehension test over the material presented in the film was administered. Information gained and arousal level while viewing the film were significantly related.

Other experimenters report similar findings. Berry[8] compared skin conductance levels with students' ability to recall a series of paired terms. He found that moderate levels of skin conductance during the first minute of learning were significantly related to recall. Behnke[9] noted similar results for running speech stimuli. Information loaded sentences were orally presented to subjects by tape recorder. Arousal levels while listening to the sentences were significantly related to information gain, but only when the difficulty-level of the material was controlled. The relationship only held for items of medium difficulty.

I am not yet ready to replace standard measures of information gain with measures of arousal. But the ability to monitor, continuously, the learning effectiveness of a student *during* the learning period suggests some rather intriguing possibilities.

I am aware that the selected studies which I have discussed do not exhaust the supply of communication related problems to which psychophysiological methods can be applied. Certainly the study of anxiety during public speaking, physiological interaction in small groups, autonomic measures of stress under the pressures of group conformity, and psychophysiological studies of communicator attractiveness warrant considerable attention. In general, researchers will be attempting to determine the optimal level of activation for a wide variety of communication activities.

I have tried to suggest a similarity between the goals and methods of psychophysiology and those of communication research in general. The future role of physiological measurement in communication will probably depend largely upon the growth and development of communication theory, advances in biomedical electronics, and to a great extent upon the ingenuity of researchers. Procuring suitable hardware is no longer a serious problem. Presently, the expense and availability of the sensing and recording devices which make up a polygraph system are within the reach of even a moderate equipment budget. And certainly the accuracy and flexibility of these instruments make them ideally suited to educational and research activities. More than an interesting side effect, from a pedagogical point of view, is the fact that an experiment involving a physiological parameter frequently serves as an excellent "case study," touching more than lightly upon a great many of the problems of research design, measurement, and statistical analysis along with serious attempts to apply these procedures to practical problems.

Another feature which serves to recommend psychophysiological research in communication is that it seems to be ideally suited for interdisciplinary research. The future development of this field of study will certainly require a good deal of cooperation from: (1) social scientists who know something about psychological processes and how they are measured, (2) biological scientists who specialize in the anatomy and physiology of the human mechanism, (3) physical scientists who develop hardware and software measuring instruments to measure the wide variety of variables which are employed in psychophysiological research, and (4) biomedicial engineers who design and develop laboratory-quality instrumentation suitable for studying human behavior with minimal restrictions imposed upon the subject and minimal contamination of the behavior being assessed. Clearly, the methods of psychophysiological research were not and could not have been developed within a single discipline. I think we would agree that the "forced" interaction which is traditionally historically and logically a part of psychophysiology only further serves to recommend it.

With increasing frequency and regularity, studies which measure human physiological responses are appearing in a widening variety of professional journals. My contention is that, in the future, communication researchers will take a greater part of this action.

PROFILE OF RALPH R. BEHNKE

Ralph R. Behnke is Assistant Professor of Speech and Director of the Communication Research Center at Florida State University. He received his B.A. from the University of Missouri-Kansas City, his M.S. from the University of Wisconsin, and Ph.D. from the University of Kansas. He studied instrumentation at the Central Technical Institute in Kansas City and is a graduate of the Air Force's advanced electronics training program in Biloxi, Mississippi. He holds both commercial and amateur communication engineering licenses issued by the Federal Communications Commission. Prior to his present appointment he taught at the University of Wisconsin, the University of Kansas, and the University of Texas. He also served as an instructor in electronic technology for the United States Air Force.

He has received communication research grants from several universities as well as from the Ford Foundation and the Hogg Foundation for Mental Health. His most recent grant provided a digital computer for the Florida State University Department of Speech. Along with its many other functions, the computer will provide high-speed electronic analysis of human physiological data in psychophysiological communication studies.

Professor Behnke is a member of the International Communication Association, the Society for the Study of Psychophysiological Research, the Speech Association of America, the Southern Speech Association, the Florida Speech Association, the American Radio Relay League, and the American Association of University Professors.

At Florida State University, he is a teaching faculty member of the Communication Theory and Research Division of the Department of Speech. His research interests focus upon psychophysiological studies of "stagefright," learning, attitudes, and attitude change.

Dr. Behnke has published in various professional journals, and has contributed chapters on psychophysiological research to two books; "Psychophysiological Technologies," in *Communication Research Methodologies* edited by Philip Emmert and William Brooks and "A Psychophysiological Approach to Communication," in *Speech-Communication Behavior* edited by Robert Kibler and Larry Barker. He is currently preparing a reference textbook on laboratory instrumentation in behavioral research.

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